

The Claims

What is claimed is:

1. A chemical mechanical polishing slurry for polishing a metal film, said slurry comprising an organic polymer abrasive.
2. The chemical mechanical polishing slurry according to claim 1, wherein said metal film comprises copper.
3. The chemical mechanical polishing slurry according to claim 1, wherein the organic polymer abrasive is poly (methyl methacrylate).
4. The chemical mechanical polishing slurry according to claim 1, wherein the organic polymer abrasive is colloidal poly (methyl methacrylate).
5. The chemical mechanical polishing slurry according to claim 1, wherein said organic polymer abrasive is present in said slurry in a weight percent ranging from about 1 to 10.
6. The chemical mechanical polishing slurry according to claim 1, wherein said organic polymer abrasive is present in said slurry in a concentration ranging from about 3 to 8 weight percent.
7. The chemical mechanical polishing slurry according to claim 1, wherein said organic polymer abrasive is present in said slurry in a concentration of about 5 weight percent.
8. The chemical-mechanical polishing slurry according to claim 1, wherein said abrasive has a particle size distribution in a range of from about 10 to 75 nm.
9. The chemical-mechanical polishing slurry according to claim 1, wherein said abrasive has a particle size distribution in a range of from about 20 to 60 nm.
10. The chemical-mechanical polishing slurry according to claim 1, wherein said abrasive has a particle size distribution in a range of from about 29 to 55 nm.

11. The chemical mechanical polishing slurry according to claim 1, further comprising an oxidizing agent and an activating agent.
12. The chemical mechanical polishing slurry according to claim 1, wherein said slurry comprises
5 from about 1 to 10 % by weight organic polymer abrasive; from about 1 to 20 % by weight oxidizing agent; from about 0 to 5 % activating agent.
13. The chemical mechanical polishing slurry according to claim 12 further comprising from
10 about 0.1 to 2 percent surfactant.
14. The chemical mechanical polishing slurry according to claim 13, wherein said surfactant is selected from the group consisting of non-ionic, cationic and anionic.
15. The chemical mechanical polishing slurry according to claim 13, wherein said surfactant is
15 anionic.
16. The chemical mechanical polishing slurry according to claim 13, wherein said surfactant is water-soluble.
17. The chemical mechanical polishing slurry according to claim 15, wherein said anionic
20 surfactant is selected from the group consisting of carboxylates, alkyl sulfates and alkyl phosphates.
18. The chemical mechanical polishing slurry according to claim 15, wherein said anionic
25 surfactant is sodium laurel sulfate.
19. The chemical mechanical polishing slurry according to claim 1, further comprising a pH modifier selected from the group consisting of: potassium hydroxide, sodium hydroxide, ammonium hydroxide and tetra methyl ammonium hydroxide wherein said pH modifier is
30 present in an amount sufficient to modify the pH to a region of about 2 to 4.
20. The chemical mechanical polishing slurry according to claim 11, wherein said oxidizing agent is selected from the group consisting of hydrogen peroxide, iodic acid, potassium iodate, and ammonium perborate.

21. The chemical mechanical polishing slurry according to claim 11, wherein said oxidizing agent is hydrogen peroxide.

5 22. The chemical mechanical polishing slurry according to claim 11, wherein said oxidizing agent is selected from the group consisting of hydrogen peroxide, iodic acid, potassium iodate, ferric nitrate, ammonium chlorite, ammonium chlorate, ammonium iodate, ammonium perborate, ammonium perchlorate, ammonium periodate ammonium persulfate, tetramethylammonium chlorite, tetramethylammonium chlorate, tetramethylammonium iodate, 10 tetramethylammonium perborate, tetramethylammonium perchlorate, tetramethylammonium periodate, tetramethylammonium persulfate, urea, 4-methylmorpholine N-oxide ($C_5H_{11}NO_2$) and pyridine-N-oxide.

15 23. The chemical mechanical polishing slurry according to claim 1, further comprising a passivating agent.

24. The chemical mechanical polishing slurry according to claim 1, further comprising a complexing agent.

20 25. The chemical mechanical polishing slurry according to claim 1, having a pH in a range of from about 0.1 to 6.9.

26. The chemical mechanical polishing slurry according to claim 1, further comprising an oxidizing agent, an activating agent, a passivating agent and a complexing agent.

25 27. The chemical mechanical polishing slurry according to claim 1, wherein said slurry comprises from about 1 to 10 % by weight organic polymer abrasive; from about 1 to 20 % by weight oxidizing agent; from about 0 to 5 % activating agent; from about 0.01 to 2 % and from about 0.01 to 3 percent complexing agent.

30 28. The chemical mechanical polishing slurry according to claim 27, further comprising a pH modifier selected from the group consisting of potassium hydroxide, sodium hydroxide, ammonium hydroxide and tetra methyl ammonium hydroxide wherein such pH modifier is present in an amount sufficient to modify the pH to a region of about 2 to 4.

29. The chemical mechanical polishing slurry according to claim 26, wherein said passivating agent is a carboxylic acid.

5 30. The chemical mechanical polishing slurry according to claim 26, wherein the passivating agent is selected from the group consisting of glycine, oxalic acid, malonic acid, succinic acid and nitrilotriacetic acid.

10 31. The chemical mechanical polishing slurry according to claim 26, wherein the passivating agent is a dicarboxylic acid.

32. The chemical mechanical polishing slurry according to claim 31, wherein the dicarboxylic acid has a nitrogen containing functional group.

15 33. The chemical mechanical polishing slurry according to claim 31, wherein the dicarboxylic acid is iminodiacetic acid.

34. The chemical mechanical polishing slurry according to claim 26, wherein the passivating agent is iminodiacetic acid.

20 35. The chemical mechanical polishing slurry according to claim 1, wherein the metal film comprises copper, a copper alloy or a copper compound having copper as its principal component.

25 36. The chemical mechanical polishing slurry according to claim 1, wherein the metal film comprises aluminum, an aluminum alloy or an aluminum compound having aluminum as its principal component.

30 37. The chemical mechanical polishing slurry according to claim 1, wherein the metal film comprises tungsten, a tungsten alloy or a tungsten compound having tungsten as its principal component.

38. The chemical mechanical polishing slurry according to claim 37, wherein the tungsten compound is a tungsten nitride.

39. The chemical mechanical polishing slurry according to claim 1, wherein the metal film is selected from the group consisting of titanium, a titanium alloy, or a titanium compound having titanium as its principal component.

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40. The chemical mechanical polishing slurry according to claim 39, wherein the titanium compound is selected from the group consisting of titanium nitride and silicon doped titanium nitride.

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41. The chemical mechanical polishing slurry according to claim 1, wherein the metal film is selected from the group consisting of tantalum, a tantalum alloy or a tantalum compound having tantalum as its principal component.

42. The chemical mechanical polishing slurry according to claim 41, wherein the tantalum compound is selected from the group consisting of tantalum nitride and silicon doped tantalum nitride.

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43. The chemical mechanical polishing slurry according to claim 26, wherein the activating agent is selected from the group consisting of inorganic and organic acids.

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44. The chemical mechanical polishing slurry according to claim 43, wherein the inorganic acid is selected from the group consisting of phosphoric acid and iodic acid.

45. The chemical mechanical polishing slurry according to claim 43, wherein the organic acid is selected from the group consisting of citric acid and malic acid.

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46. The chemical mechanical polishing slurry according to claim 26, wherein the complexing agent is selected from the group consisting of citric acid and malic acid.

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47. The chemical mechanical polishing slurry according to claim 26, further comprising potassium hydroxide, sodium hydroxide or ammonium hydroxide in such amounts to modify the pH to a region of about 0.1 to 6.9.

48. The chemical mechanical polishing slurry according to claim 1, wherein said slurry comprises about 5 percent poly (methyl methacrylate) abrasive, about 5 percent hydrogen peroxide, about 0.1 percent citric acid, about 0.2 percent iminodiacetic acid, about 0.013 percent ammonia, and about 90 percent water.

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49. The chemical mechanical polishing slurry according to claim 48 having a pH of 2.5.

50. A method for chemical mechanical polishing copper, barrier material and dielectric material, from a semiconductor substrate, said method comprising the steps of:

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a) providing a first chemical mechanical polishing slurry composition comprising an organic polymeric abrasive;

b) chemical mechanical polishing the semiconductor wafer substrate surface with said first slurry;

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c) providing a second chemical mechanical polishing slurry composition, wherein said second slurry has a higher removal rate on said barrier material than said copper material; and

d) chemical mechanical polishing said semiconductor wafer substrate surface with said second slurry.

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